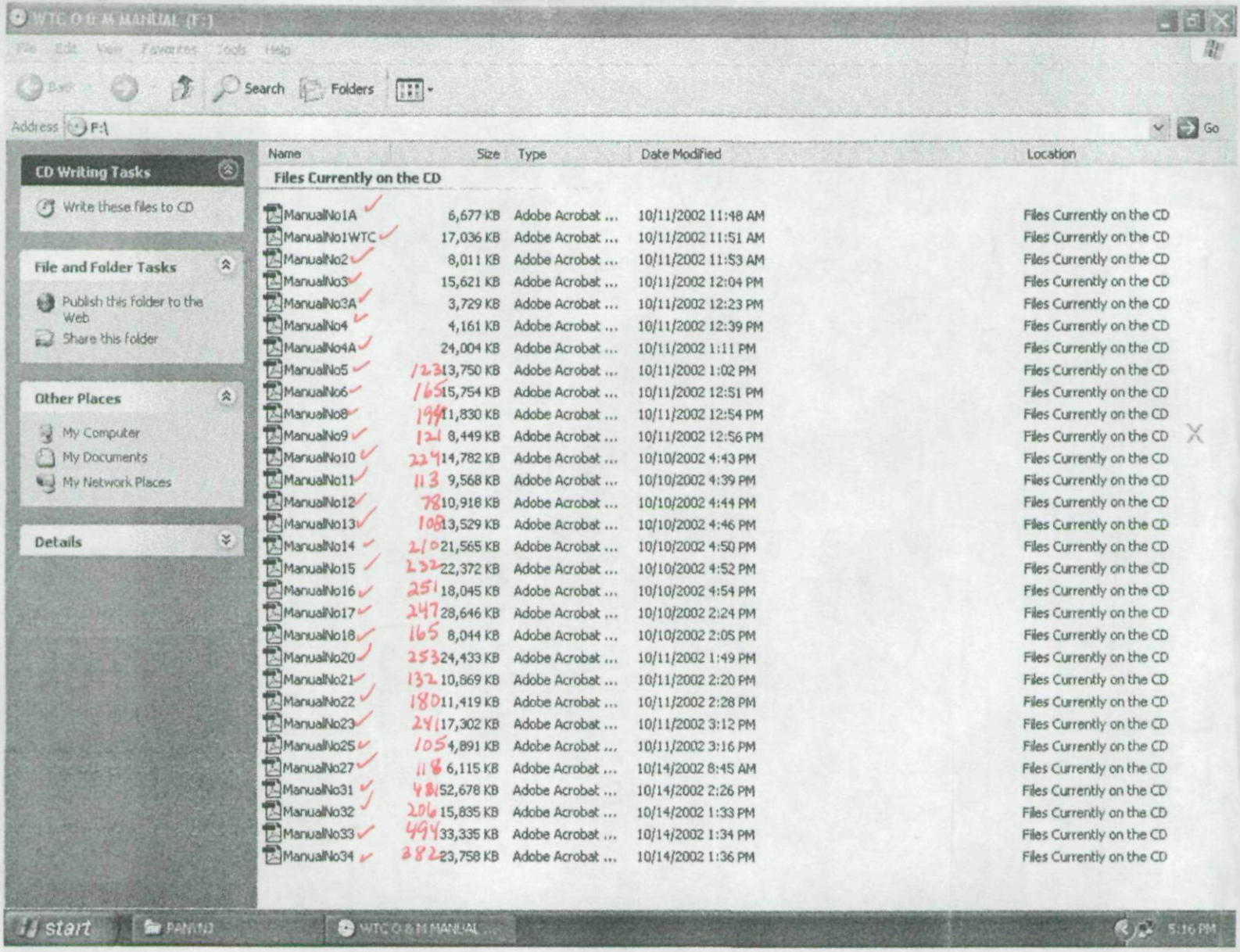

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THE PORT AUTHORITY OF NY & NJ

1 world trade center

Operation & Maintenance

river water pump station

WORLD TRADE CENTER

Instruction Manual No.1

Operation and Maintenance of

RIVER WATER PUMP STATION

Final Edition
Engineering Department
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THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The material contained herein includes operating and maintenance instructions for all equipment and piping related to the handling of river water within the River Water Pump Station. Also included are instructions for the underground river water piping leading from the pump station to the World Trade Center as well as the effluent piping leading from the World Trade Center to the Hudson River.

The subject matter is intended to serve as a guide for personnel in the performance of their duties in the operation and maintenance of the equipment and systems described. All operating and maintenance personnel must nonetheless comply with all Port Authority accepted safety practices and precautions as well as with the instructions provided by the plant supervisory staff.

The material has been compiled, researched, organized, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department.

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CHAPTER I

INTRODUCTION

SCOPE

The purpose of this manual is to describe the mechanical and electrical systems of the River Water Pump Station as well as the underground piping associated with the pump station and located on the west side of the perimeter wall surrounding the World Trade Center. River water piping and related equipment located on the east side of the perimeter wall shall be described in a separate manual describing the WTC refrigeration plant. This manual also includes operating and maintenance procedures related to individual items of equipment as well as the entire system.

GENERAL

The River Water Pump Station is located below grade level in the Battery Park City landfill area directly west of the south side of Tower A. Its purpose is to pump salt water from the Hudson River to the WTC refrigeration plant while at the same time removing trash and particles greater than 3/8-inch mesh. Seven 12,900 gpm pumps, the main river water pumps, are used to pump river water through a 60-inch diameter pipeline to as many as seven centrifugal refrigeration machines. One pump has enough capacity to meet the condenser water needs of one centrifugal machine. The pumps also supply water continuously, 24 hours per day, for most of the year to a separate computer cooling system. A single 7400 gpm pump, the auxiliary river water pump, is used as a standby for main river water pumps nos. 1,2,3,6, and 7 whenever the 60-inch discharge line is shut down for repairs. This auxiliary pump as well as the main river water pumps nos. 4 and 5 are able to discharge into a 20-inch line. Pumps nos. 4 and 5 can discharge into either the 60-inch or 20-inch pipelines. For computer cooling purposes, some of the water is pumped

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WORLD TRADE CENTER

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Operation and Maintenance of

RIVER WATER PUMP STATION

DRAFT

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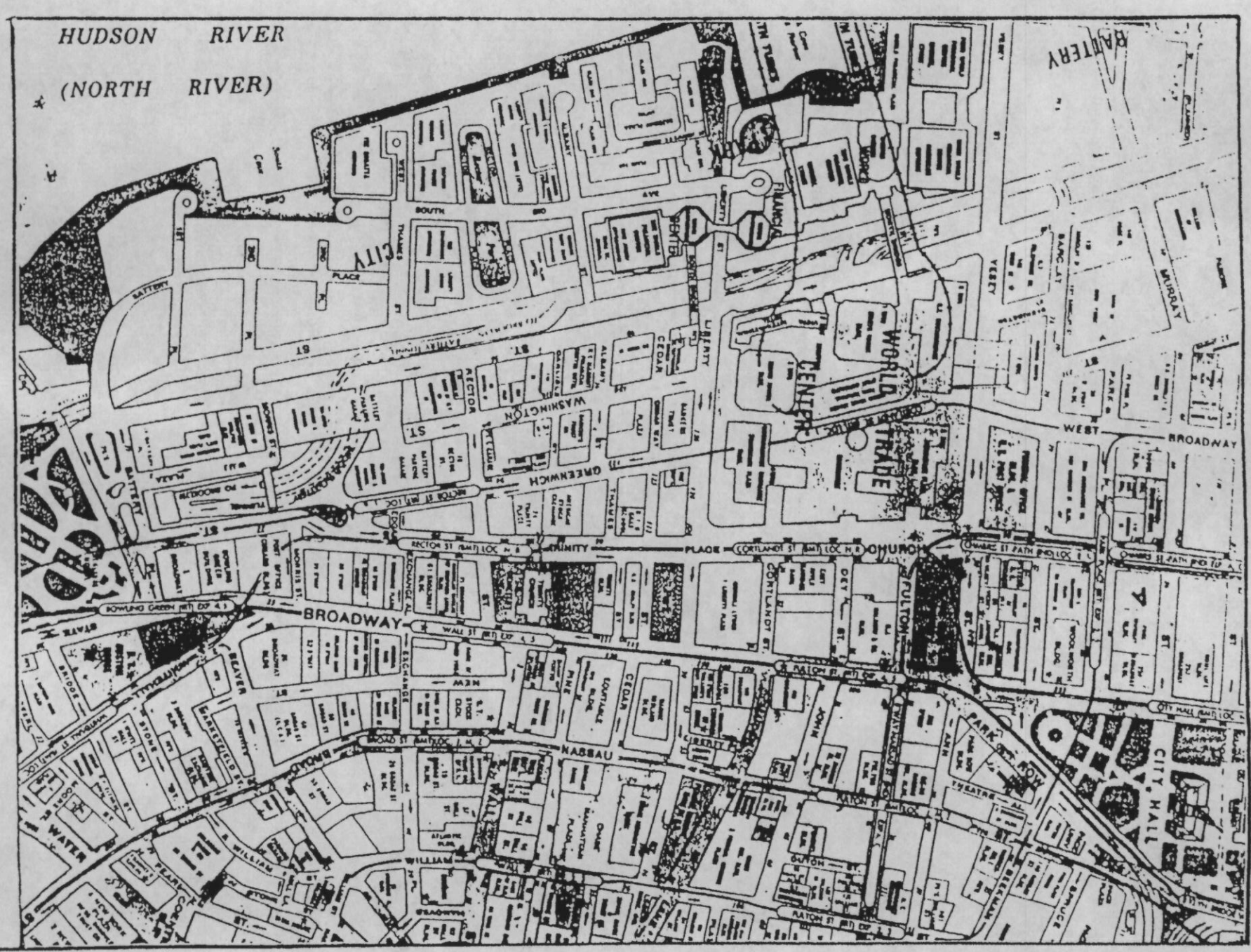
HUDSON RIVER
(NORTH RIVER)
BATTERY
CITY
BROADWAY
WEST BROADWAY
WORLD TRADE CENTER
WASHINGTON
GREENWICH
TRINITY PLACE
CORTLANDT
FULTON
NASSAU
WILLIAM
WATER
PARK ROW
CITY HALL

F O R E W O R D

This manual is titled "Instruction Manual No. 1A and replaces Instruction Manual No. 1.

This updated version was necessitated by mechanical and electrical changes to the river water pumping station. The major changes are increased pumping capability, additional controls to achieve pump motor protection with remote annunciation, new water treatment pumps and an entirely new ventilation system. There have also been several changes to the piping system.

In addition, the manual has been entirely rewritten in order to make it a more user-friendly instructive narrative.

The material has been compiled, researched and organized with the tireless aid of the Maintenance Section of the Design Division for Maintenance Engineering, Engineering Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The purpose of this manual is to describe the mechanical and electrical systems of the River Water Pump Station and the underground piping associated with the pump station located on the west side of the perimeter wall surrounding the World Trade Center.

River Water piping and related equipment located on the east side of the perimeter wall is addressed in a separate manual describing the WTC refrigeration plant.

This manual includes operating and maintenance procedures related to individual items of equipment and the entire system.

GENERAL

The River Water Pump Station is located below grade level in the Battery Park City landfill area directly west of the south side of 2 World Trade Center. It pumps salt water from the Hudson River to the WTC refrigeration plant after removing trash and particles greater than 3/8-inch mesh.

There are 8 main river water pumps. Pumps 1, 4, 5 and 8 can deliver 12,900 GPM to either the 60" or the 20" pipe feeding the World Trade Center refrigeration plant and the 24-hour computer cooling system. Pumps 2, 3, 6 and 7 deliver 18,000 GPM to the 7 centrifugal refrigeration machines.

For computer cooling purposes, some of the water is pumped through a pair of heat exchangers located on the 264-foot level (B4) of the WTC basement to produce chilled water for cooling various computer rooms located throughout the WTC complex.

In the event of a general electric power failure at the WTC, all of the main and auxiliary river water pumps will shut down, but two small 1290 GPM pumps, the emergency river water pumps, will automatically start up and supply just enough water to cool two groups of diesel-driven electric power generators located on the 242-foot level (B6) of the WTC. One group of generators is controlled and operated by the Port Authority. The second group of generators is controlled and operated by The New York Telephone Company.

The pump station serves the WTC by means of two underground pipelines: a 60-inch pipe and a 20-inch pipe. The 60-inch pipe is used primarily by the main river water pumps and the 20-inch pipe is used primarily for computer cooling and also serves as a standby whenever the 60-inch pipeline is out of service for any reason. The piping within the basement of the WTC is so arranged that either of the two

pipes may be used to supply water for the centrifugal machines or for computer cooling.

GENERAL DESCRIPTION OF PUMP STATION

General

The pump station is an underground building approximately 67 feet wide by about 100 feet long. The roof of the structure is called Pumphouse Park. The operating floor, located 2 feet above the river median high water level, contains most of the mechanical and electrical equipment. See figures 1-1 through 1-5. For reference purposes, the median high water level is 300 feet.

River water enters the pump station through a north and south horizontal intake tunnel each 7-foot high x 10-foot wide. The tunnels on the inlet side penetrate one of the circular steel cells surrounding the Battery Park City landfill area. The bottoms of the tunnels are flush with the bottom of the pump station chambers at a level of 280 feet. Both tunnel inlets are equipped with monel bar screens containing bars spaced at 5-inch intervals. River water then enters the pump station through a pair of sluice gates and passes to the north and/or south settling chambers. Due to the much greater cross-sectional areas of the settling chambers as compared to the areas of the intake tunnels, the velocity of the water is reduced. This reduction in water

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THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide Port Authority personnel who operate and maintain the Remote Lighting Control System at the World Trade Center.

This manual should be used with, and must comply with, instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

P R E F A C E

The Remote Lighting Control System for the Southeast Plaza Building of the World Trade Center complex is not included in this manual since it was not installed at the time of preparation of this manual.

World Trade Center personnel should request an updating of this manual when the system is completely installed or other major changes are made.

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CHAPTER I

INTRODUCTION

SCOPE

This manual deals with the Remote Lighting Control System of the tenant office areas at the World Trade Center. Chapter I provides a general description of the system, power supply, and equipment arrangement. Chapter II describes the individual items of equipment employed in the Local and Remote Lighting Control Systems. Chapter III focuses on the system power supply, signal, remote multiplex terminal/subrelay station, and overall system distribution. Chapter IV explains the system operation under various conditions. Chapter V includes maintenance recommendations. This manual does not describe the security and alarm systems, even though some of the equipment described herein also functions for those systems.

GENERAL DESCRIPTION OF SYSTEM

The Remote Lighting Control System at the World Trade Center provides the capability of performing ON/OFF lighting control for 200 tenant floors from a single control point, the Control Center in the Security Room on subgrade level B1 (elevation 294 feet). There is also a provision for the local control of tenant floor lights by means of key-operated switches on the individual floors and by means of toggle switches on some floors. The Remote Lighting Control System consists of a control console, teletype keyboard and printer (TTY), alarm display and acknowledge terminal (ADAT), data transmission cables (DTC's), system power supply (SPS) units, remote multiplex terminals (RMT's), subrelay stations (R's), and lighting contactors. Some of these components are shown in the system block diagram presented in Figure I-1. The control console consists of dual general purpose computers, dual central multiplex terminals (CMT's), a link control unit, and a

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208 pages

WORLD TRADE CENTER

Instruction Manual No. 3

Operation and Maintenance of

MECHANICAL SYSTEMS
CENTRAL REFRIGERATION PLANT

Final Edition
Engineering Department
Publication, December 1978

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

This manual provides mechanical operating and maintenance instructions for the refrigeration equipment and related systems within the WTC Refrigeration Plant. Electrical operating and maintenance instructions for the compressor motors and pump motors as well as for the power distribution equipment supplying those motors are provided in a separate manual.

The subject matter is intended to serve as a guide for personnel in the performance of their duties in the operation and maintenance of the equipment and systems described. All operating and maintenance personnel must nonetheless comply with all Port Authority accepted safety practices and precautions as well as with the instructions provided by the plant supervisory staff.

The material has been compiled, researched, organized, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

P R E F A C E

This manual reflects the as-built condition of the systems as of the date when each chapter was researched and investigated. Due to modifications that may have been made after that time, the manual may contain some discrepancies which may require an updating of the manual in the future. The World Trade Department should request an updating of the manual when it is felt that the manual no longer adequately represents the Refrigeration Plant and related systems in their current state.

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WORLD TRADE CENTER

Manual No. 3A

Operation and Maintenance

MECHANICAL SYSTEMS
CENTRAL REFRIGERATION PLANT
(Supplementary Manual for the 2,500-Ton Chillers)

FOR REVIEW ONLY
(UPDATED COPY)

Engineering Department
Publication, ***JULY 1990***

THE PORT AUTHORITY OF NY & NJ

P R E F A C E

This manual describes the systems and operating procedures in use at the issue date of the manual. Future systems changes will require revisions in the manual. The World Trade Department should request changes in the manual as refrigeration-plant systems change.

F O R E W O R D

This manual gives mechanical operating and maintenance instructions for the 2,500-ton centrifugal chiller, refrigeration equipment, and related systems. Another manual gives electrical operating and maintenance instructions for the compressor motors and pump motors as well as instructions for the power-distribution equipment supplying those motors.

This manual is a guide for operating and maintenance personnel who must also comply with Port Authority accepted safety procedures and instructions from their supervisory staff.

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117 pages

WORLD TRADE CENTER

Manual No. 4

Operation and Maintenance

ELECTRICAL SYSTEMS

CENTRAL REFRIGERATION PLANT

Final Edition
Engineering Department
Publication, December 1977
Reprinted, November 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to Port Authority personnel who operate and maintain the Electrical Systems of the Central Refrigeration Plant in the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures applicable to the World Trade Center. Supplementary, detailed information on the major components of the Electrical Systems of the Central Refrigeration Plant is supplied in Manual No. 4a.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

P R E F A C E

The information and diagrams provided in this manual reflect the status of the equipment and circuitry as it existed upon the completion of research for the manual.

World Trade Center personnel should request revisions to this manual for all changes to equipment and circuitry that have occurred since that time.

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CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the electrical power distribution systems in the Central Refrigeration Plant of the World Trade Center. Chapter 1 is an introduction to the manual. It includes a layout showing the locations of all the major electrical equipment in the refrigeration plant. Chapter 2 deals with the distribution of the 13.8 KV main power to the 7,000 hp. compressor motors. Included in this chapter are detailed descriptions of the power centers located on the mezzanine level of the refrigeration plant and a foldout one-line diagram of the 13.8 KV Main Power Distribution System.

Chapter 3 focuses on the refrigeration motor starters that control, operate, and protect the 7,000 hp. compressor motors. The chapter contains a foldout schematic of a typical refrigeration motor starter (7,000 hp. Motor Starter Switchgear) and York Unit Control Panels. Chapter 4 is concerned with the 480V Power Distribution Systems in the plant. Included in the chapter are a one-line diagram of the distribution system, schedules of the distribution panels in the system and information concerning the Motor Control Center. Chapter 5 is devoted to the dc power supplies which provide the 48V dc power that is required for controlling, tripping, and closing operations in the power centers and the motor starters.

GENERAL

The Main Power Distribution System for the Central Refrigeration Plant comprises seven feeders that supply power to

seven power centers located in the refrigeration plant. See Figure 1-1. The seven power centers control the power required for the heavy cooling equipment motors. These motors include the 7,000 hp. synchronous motors that drive the refrigeration compressors, the Chilled Water Circulating Pumps, and the River Water Pumps that are located in the River Water Pump Station. Detailed information concerning the power centers is provided in Chapter 2.

Each of the seven synchronous motors is provided with its own switchgear cabinet. Housed in this cabinet are two drawout air circuit breakers, relays, switches, and miscellaneous associated electronic and electromechanical components. Detailed information concerning the Motor Starter Switchgear is provided in Chapter 3.

The 480V Power Distribution System feeds many auxiliary systems associated with the refrigeration plant. Feeders for this system originate in Substations 294A and 294B and terminate in distribution panels located on the northwest wall of the plant. See Figure 1-1.

NOTES ON APPENDICES

Appearing in the rear of this manual are four appendices. They are: "Abbreviations for Text", "Electrical Symbols", "Abbreviations for Drawings", and "Special Legend". The "Abbreviations for Text" listing comprises the explanations of all the standard abbreviations used in the writing of the text of this manual. The "Abbreviations for Drawings" legend contains definitions of the standard abbreviations utilized in the diagrams in the manual. The "Electrical Symbols" listing contains the meanings of all the standard electrical symbols used in the diagrams in this manual. The "Special Legend" includes explanations of all the special electrical designations and symbols originated specifically for the subject matter in this manual.

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WORLD TRADE CENTER

Instruction Manual No. 4a

SUPPLEMENTARY PUBLICATIONS

ELECTRICAL SYSTEMS
CENTRAL REFRIGERATION PLANT

Engineering Department
Publication, November 1976

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WORLD TRADE CENTER

Instruction Manual No. 4a

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CENTRAL REFRIGERATION PLANT

Engineering Department
Publication, November 1976

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

This book has been compiled by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, at the request of the Electrical Section of the Operations Division of the World Trade Department as a supplement to World Trade Center Instruction Manual No. 4, "Electrical Systems - Central Refrigeration Plant".

The publications and diagrams included in this book contain manufacturers' data pertaining to the receiving, handling, storing, installing, maintaining, adjusting, and servicing of most of the major assemblies and subassemblies comprising the electrical systems of the Central Refrigeration Plant. Since the data contained in these manufacturers' drawings and publications have not been verified by the Maintenance Methods Section, their accuracy cannot be assured.

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RENEWAL PARTS

Quotation No. SLS- 7539

ELECTORQUE ASSOC. INC.

WORLD TRADE CENTER
WOODSIDE, NEW YORK

REQ'N. 300-92819

Renewal Parts which we recommend that purchaser carry in stock for normal maintenance or for emergency conditions, for the switchgear equipment furnished on this requisition, are listed on the following pages.

It is estimated that shipment can be made in approximately 24 weeks after the receipt of an order, with complete information.

Quoted prices of breaker elements are List (Go-225 applies).
Quoted prices of other complete devices are Net.
Quoted prices of recommended spare parts are List (GO-46R applies).

Quoted prices are prepared for domestic delivery, f.o.b., point of shipment, with the transportation charges prepaid (allowed).

It is recommended that quantities supplied be determined by ordering one of each item for each 10 devices of that item as shown below.

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ITEM	QUANTITY	CATALOG NUMBER	DESCRIPTION	LIST EACH GO-225
1	8	733-224A5988-1	AM-13.8-1000-3H, 1200 Amp Breaker Element	$14,115.00
2	7	721-10AA008	SBM Control Switch	25.50
3	7	10AA125	SBM Control Switch	20.50
4	7	10AX002 G-3	SBM Auxiliary Switch	
5	7	12IAC51B2A	IAC Relay	132.00
6	21	12IAC51B101A	IAC Relay	132.00
7	21	116B6708 G-2	ET-16 Indicating Lamp	

SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

E.A.Roth 10-24-70

MVS

GENERAL ELECTRIC COMPANY

Quotation ... SLS-7539

RENEWAL PARTS RECOMMENDATIONS

Catalog Number	Description	Quantity Per Device	List Price Each
	ITEM 1		
	RECOMMENDED BREAKER RENEWAL PARTS FOR THE TYPE AM-13.8-1000-3H MAGNE-BLAST BREAKER, 1200 AMPERE WITH STORED-ENERGY MECHANISM:		
FOR BREAKER:			
733-281B708 G-7	Operating rod assembly	3	$ 11.50
966C354 G-2	Stationary arcing contact assembly	3	110.00
966C351 G-3	Flexible connection (left)	3	.55
966C351 G-4	Flexible connection (right)	3	.55
966C352 P-7	Insulating plate	3	5.30
6445087 P-4	Buffer	3	1.40
6557243 P-2	Buffer clamp	6	.40
966C352 P-10	Lower runner insulation (left)	3	12.50
966C352 P-9	Lower runner insulation (right)	3	12.50
105C9396 G-2	Arc chute throat (left)	3	73.00
105C9396 G-1	Arc chute throat (right)	3	73.00
414A180 P-1	Primary contact finger spring	24	.65
114C5382 P-2	Primary contact finger	24	7.60
966C353 G-1	Movable arcing contact	3	38.00
688C595 P-22	Movable primary contact (outside, left)	3	13.50
688C595 P-21	Movable primary contact (outside, right)	3	13.50
6591644 P-7	Movable primary contact (inside, left)	3	13.50
6591644 P-8	Movable primary contact (inside, right)	3	13.50
FOR MECHANISM:			
105C9393 P-1	Motor	1	161.00
137A7575 P-4	Relay	1	20.50
6275C70 G-2	Release & trip coil	2	42.50
456A866 P-5	Switch, normally open	5	4.80
456A866 P-6	Switch, normally closed	1	4.80
10AX006 G-4	Auxiliary switch	1	40.00
161A4231	Closing latch spring	1	.40
137A5252	Prop spring	1	1.80
161A5909	Pawl spring	3	1.80
	BULLETIN GEI-88766		
733-685C810 G-3	Spare breaker elevating motor	1	325.00

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

RENEWAL PARTS RECOMMENDATIONS

Catalog Number	Description	Quantity Per Device	List Price Each
	ITEM 2		
	MODEL 721-10AA008		
	TYPE SBM CONTROL SWITCH:		
721-127A6770 G-1	Moving contact assembly	6	$ 1.80
127A6749 G-1	Stationary contact, upper	6	1.10
127A6751 G-1	Stationary contact, lower	6	1.10
165A6178	Detent spring	1	.20
	BULLETIN GEF-4167		
	ITEM 3		
	MODEL 721-10AA125		
	TYPE SBM CONTROL SWITCH:		
721-127A6770 G-1	Moving contact assembly	2	1.80
127A6749 G-1	Stationary contact, upper	2	1.10
127A6751 G-1	Stationary contact, lower	2	1.10
127A6775 P-1	Torsion spring	1	1.40
	BULLETIN GEF-4167		
	ITEM 4		
	MODEL 721-10AX002 G-3		
	TYPE SBM AUXILIARY SWITCH:		
721-127A6770 G-1	Moving contact assembly	6	1.80
127A6749 G-1	Stationary contact, upper	6	1.10
127A6751 G-1	Stationary contact, lower	6	1.10
	BULLETIN GEF-4167		
	ITEM 5		
	MODEL 721-12IAC51B2A		
	TYPE IAC RELAY:		
721-891B45) G-22	Operating coil assembly	1	40.50
615853(G-1	Moving contact & spring assembly	1	12.00
620943) G-1	Stationary contact	1	.55
629320) G-3	Seal-in unit	1	24.50
629320' G-19	Instantaneous unit	1	38.00
	BULLETIN GEF-3883		

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

GENERAL ELECTRIC COMPANY

Quotation No. SLS- 7539

RENEWAL PARTS RECOMMENDATIONS

Catalog Number	Description	Quantity Per Device	List Price Each
	ITEM 6 MODEL 721-12IAC51B101A TYPE IAC RELAY:		
721-8918450 G-1	Operating coil assembly	1	$ 40.50
6158531 G-1	Moving contact & spring assembly	1	12.00
6209430 G-1	Stationary contact	1	.55
6293203 G-3	Seal-in unit	1	24.50
6293204 G-19	Instantaneous unit	1	38.00
	BULLETIN GEF-3883		
	ITEM 7 MODEL 721-116B6708 G-2 TYPE ET-16 INDICATING LAMP:		
721-116B6708 G-2	Spare Indicating Lamp, complete with *color cap *specify color desired	1	6.60
1835	Spare Indicating Lamp Bulb	1	.40
	BULLETIN GEF-4326		

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

INSTRUCTIONS AND
RECOMMENDED PARTS
FOR MAINTENANCE

GEH-1802V
Supersedes
GEH-1802U & GEF-3837

METAL-CLAD SWITCHGEAR

Types M26 and M36

FOR MAGNE-BLAST AIR CIRCUIT BREAKER

TYPES AM-4.16 AND AM-13.8

SWITCHGEAR PRODUCTS DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

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WTCI-5-P

123 pages

WORLD TRADE CENTER

Instruction Manual No.5

Operation and Maintenance of

HIGH VOLTAGE DISTRIBUTION SYSTEM

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THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to Port Authority personnel who operate and maintain the High Voltage Distribution System of the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

P R E F A C E

The information and diagrams provided in this manual reflect the status of the equipment and circuitry as it existed upon the completion of research for the manual.

World Trade Center personnel should request revisions to this manual for all changes to equipment and circuitry that have occurred since that time.

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CHAPTER 1

INTRODUCTION

SCOPE

The topic of this manual is the High Voltage Distribution System of the World Trade Center. Chapter 1 is an introduction to the manual. It contains an explanation of the designation system used in the Center and an account of the appendices that are presented in the rear of the manual. Chapter 2 focuses on the distribution system as a whole. It includes a one-line cable diagram of the system and layout plans of its Primary Distribution Center and substations.

Chapter 3 deals with the Primary Distribution Center. It contains descriptions of the air circuit breakers (ACB's), their cubicles, and the metering system. Also included are detailed explanations of: the Emergency Trip Circuit; the 120V dc Supply; and signals to the Honeywell Computer. Chapter 4 is concerned with the substations of the High Voltage Distribution System. It includes descriptions of: the primary disconnect and grounding switches and their operating procedures; the network transformers; and their hottest spot indicators.

GENERAL

Installed transformer capacity in the Trade Center, which includes a large margin for future growth, has a total rating of 135,000 KVA. This capacity is distributed among 90 network transformers rated at 1500 KVA each. Their locations within the substations are shown on partial plan layouts in Chapter 2,

165 pages

WORLD TRADE CENTER

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Operation and Maintenance of

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Engineering Department
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Instruction Manual No. 6

Operation and Maintenance of

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Final Edition
Engineering Department
Publication, August 1982

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented to aid Port Authority personnel who operate and maintain the Electrical Systems at the World Trade Center.

This manual should be used, with, and must comply with, instructions in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been compiled, researched, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the Low Voltage Power Distribution Systems of Towers A and B.

Chapter 1 provides a general view of the High and Low Voltage Power Distribution Systems installed in both towers.

Chapter 2 deals with the High Voltage Switchgear Cabinets in the substations and the alarm system related to them.

Chapter 3 focuses on the Distribution Switchboards of the system. The subject matter includes the Main Distribution Switchboards that were installed in the towers at the time of construction and the subdistribution switchboards that were installed on the 109th floor of Tower A at a later date.

Chapter 4 describes the Motor Control Centers in the towers. Included in the chapter is a listing of the manufacturer's shop drawings of the Motor Control Centers and the controllers housed in the centers.

Chapter 5 provides information on the subdistribution panels and power metering equipment in the towers.

Chapter 6 serves as a guide to maintenance personnel charged with the responsibility for maintaining the electrical equipment in the towers.

Chapter 7 concerns the Low Voltage Distribution System in Tower B. Contained in the chapter are descriptions of the differences between the systems in Towers A and B.

GENERAL

Electric power for the World Trade Center is purchased from the Power Authority of the State of New York (PASNY), and delivered by Consolidated Edison (Con Ed) via a substation located north of the Trade Center on Vesey Street. Power from the Con Ed substation is conducted underground at 13.8 KV via cables, 2 in parallel for each of the 8 incoming feeders, to a Primary Distribution Center (PDC).

The PDC is on Level B3 (Elevation 274') in the extreme northeast corner of the World Trade Center. The PDC receives the 8 Con Ed feeders and subdivides them into 3 groups of 8 secondary, 13.8 KV feeders and 1 group of seven 13.8 KV feeders. One group of feeders feeds the 8 abovegrade substations in Tower A. See Figure 1-1. The second group feeds the 8 substations in Tower B.

The third group of 8 feeders serves the substations in the sublevels of the towers and the Northeast and Southeast Plaza Buildings. The group of 7 feeders feeds the Central Refrigeration Plant.

For a comprehensive description of the High Voltage Distribution System, refer to World Trade Center O&M Manual No. 5 "High Voltage Distribution System".

PRIMARY DISTRIBUTION CENTER

The PDC consists of 8 switchgear groups which are designated PDC No.1 (PDC-1) thru PDC No.8 (PDC-8). Each switchgear group contains 6 cubicles, of which at least 1 is a spare. Each Con Ed incoming feeder feeds 1 switchgear group via an ACB in that group. Four secondary feeders from each group serve different parts of the WTC complex, as described in the "General" section above. For a complete description of the PDC refer to World Trade Center O&M Manual No.5 "High Voltage Distribution System".

Each cubicle in the PDC contains a draw-out ACB, rated at 1200A continuous current with an interrupting capacity of 1000

131 pages

WORLD TRADE CENTER

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EMERGENCY POWER DISTRIBUTION SYSTEM

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F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide Port Authority personnel who operate and maintain the Emergency Power Systems at the World Trade Center complex.

This manual should be used with, and must comply with, instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

This manual describes the electrical equipment and systems of the emergency power in use at the World Trade Center (WTC) complex, excluding the Hotel.

Chapter 1 discusses the need for emergency power, the location of equipment, and the appendices.

Chapter 2 describes the diesel engines, their controls, protection, and associated auxiliary equipment.

Chapter 3 describes the electrical generator, its control and protection, and the synchronization system. The chapter concludes with a description of the generator and main ACB's.

Chapter 4 discusses the Emergency Power Center (EPC) as part of the Emergency Power Distribution System.

Chapter 5 describes the automatic transfer switches (ATS's) in the system as well as the Main Transfer Switch Control Panel.

Chapter 6 discusses the operating procedures of the system, viz, the starting and stopping of the emergency generators. In this chapter the system of load sharing among the generators is also described. The chapter concludes with a discussion of the indicating alarm (both visual and audible) systems in use.

GENERAL

The World Trade Center complex is provided with emergency power to operate the emergency lighting loads, elevator

loads, and fire fighting equipment (including the Fire Department Elevators) so that everyone can be evacuated from the buildings in the event of a utility power failure. Emergency power is not designed to replace total utility power for the day-to-day operations of the WTC complex.

The emergency lighting loads include the stairway and exit lights, corridor lighting, and other essential areas of the complex.

The emergency generator will start automatically only when power to the emergency lighting panels fails.

EQUIPMENT LOCATION

There are five 1000 KW generators located in Level B6, alongside stairway K-1A. See Figure 1.1. The diesel engine generators, together with their battery set, are installed adjacent to one another in the Emergency Generator Room. Located in this same room are the Engine-Generator Control Panels, the Master Control Panel, and the Main Distribution Boards. Behind these panels are located the Emergency Switchboards (ESB). The automatic transfer switches of this power system are located on various floors of the Towers, as well as in the other buildings and the subgrade levels of the complex.

NOTES ON APPENDICES

In this manual the Abbreviations For Text will be found in Appendix A, the Electrical Symbols in Appendix B, the Abbreviations For Drawings in Appendix C, and the Special Legend in Appendix D. This legend is a general list of the abbreviations and letter symbols used for this power system.

WTCI-5-P

121 pages

WORLD TRADE CENTER

Instruction Manual No. 9

Operation and Maintenance of

PLAZA SCULPTURE FOUNTAIN SYSTEM

Final Edition
Engineering Department
Publication, March 1980

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented to aid Port Authority personnel who operate and maintain the Plaza Sculpture Fountain at the World Trade Center.

This manual should be used with, and must comply with, instructions in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been compiled, researched, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department.

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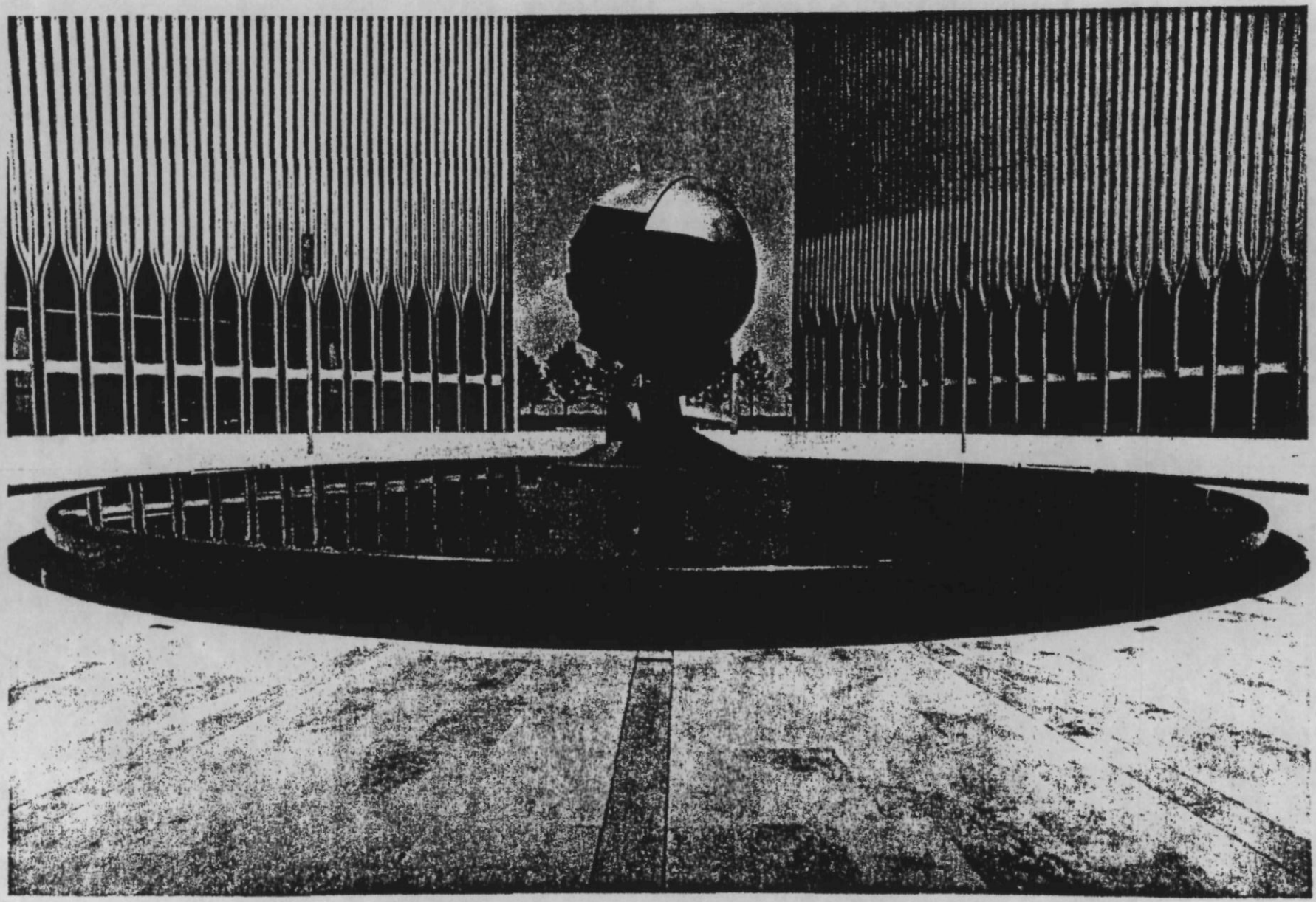

CHAPTER I

INTRODUCTION

SCOPE

The equipment, operation, and maintenance of the Sculpture Fountain System are discussed in this manual. This chapter is the general introduction to the system and includes a flow diagram, valve index, and the location of the mechanical and electrical components. Chapter 2 contains the descriptions of the major components in the system. The mechanical and electrical controls for the system are discussed in Chapter 3. The filter package is described in Chapter 4, which also includes a description of the filter system's control circuits and chemicals. A step-by-step operational procedure is presented in Chapter 5 and the maintenance recommendations are provided in Chapter 6.

GENERAL DESCRIPTION

The Sculpture Fountain System provides a filtered and chemically treated water stream, ejected from a continuous nozzle, which arcs close to the midpoint of the sculpture platform. The throw of water to the point of impact can be varied. The water is collected in the trough at the foot of the platform and recirculated by the Sculpture Fountain Pumps which are also referred to as the supply pumps. An automatic strainer separates accumulated solids from the returned pool water. There are four Sculpture Fountain Pumps located in the Pool Equipment Room (PER). Two running pumps are required to supply the discharge for the desired throw of water. The other two supply pumps are alternated into the operation.

224 pages

WORLD TRADE CENTER

Instruction Manual No. 10

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM NORTHEAST AND SOUTHEAST PLAZA BUILDINGS

Final Edition
Engineering Department
Publication, September 1984

THE PORT AUTHORITY OF NY & NJ

WORLD TRADE CENTER

Instruction Manual No. 10

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM NORTHEAST AND SOUTHEAST PLAZA BUILDINGS

Final Edition
Engineering Department
Publication, September 1984

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Low Voltage Distribution System of the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

P R E F A C E

This manual is written in two sections: the first section covers the Northeast Plaza Building and the second the Southeast Plaza Building.

Each section contains its own Table of Contents, List of Illustrations, and descriptive chapters.

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CHAPTER 1

INTRODUCTION

SCOPE

This manual is written in 2 sections: the first section provides information about the Low Voltage Distribution System in the Northeast Plaza Building (NEPB); the second section covers the Low Voltage Distribution System in the Southeast Plaza Building (SEPB).

Chapter 1 of this section of the manual is its Introduction. It describes the organization of the section and contains general information regarding the Low Voltage Distribution System in the NEPB.

Chapter 2 describes the distribution system of the NEPB.

Chapter 3 focuses on the Substation in the building, and includes information regarding the major components in the Substation.

Chapter 4 covers the distribution panels in the NEPB, and includes schedules of the panels.

Chapter 5 provides maintenance information and recommendations for the major electrical components in the system, and system troubleshooting procedures.

113 10220

WORLD TRADE CENTER

Instruction Manual No. 11

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM SUBGRADE LEVELS

Final Edition
Engineering Department
Publication, October 1984

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WORLD TRADE CENTER

Instruction Manual No. 11

Operation and Maintenance of

LOW VOLTAGE DISTRIBUTION SYSTEM SUBGRADE LEVELS

Final Edition
Engineering Department
Publication, October 1984

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Low Voltage Distribution System of the World Trade Center.

This manual should be used with, and must comply with the instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The Low Voltage Electrical Distribution System in the 6 sublevels of the towers and Subgrades of the World Trade Center is the subject of this manual.

Chapter 1 is the Introduction to the manual and contains a general description of the Subgrade areas.

Chapter 2 describes the distribution system.

Chapter 3 deals with the substations in the distribution system and the major distribution equipment in the substations.

Chapter 4 is concerned with the special distribution panels in the system.

Chapter 5 contains the maintenance requirements, procedures, and troubleshooting required to keep the electrical equipment in good operating order.

GENERAL

The Subgrade levels of the World Trade Center comprise 6 floors of space in the Sublevels (basement) of the towers and 6 levels of space below grade in the areas adjacent to the towers. See Figure 1-1.

The area north, east, and west of Tower A on the Concourse Level is designated the J area; the area north, east, and south of Tower B is designated the K area. The same Subgrade and Sublevel area designations are repeated for 6 additional levels down to Level B6 (Elevation 242'). See Figure 1-2.

Each level of the Subgrades encompasses an area of approximately 45,000 square feet (including PATH's station and track areas):

Elevation 310' includes the western end of the Concourse, the area beneath the U.S. Customhouse, and the lobbies of Towers A and B. See Figure 1-1.

Level B1 (Elevation 294') includes: the truck docks for Towers A and B, the Hotel's parking area, the Security Control Room (Police Desk), INHILCO's commissary, and some janitorial service offices.

Level B2 (Elevation 284') comprises electrical, mechanical, and structural maintenance shops and offices, parking areas, and many elevator pits.

Level B3 (Elevation 274') consists mainly of parking and tenant storage areas.

Level B4 (Elevation 264') also is used mainly for parking and tenant storage.

Level B5 (Elevation 253') includes the Refrigeration Plant's operating level and additional tenant storage.

Level B6 (Elevation 242') houses 2 Mechanical Equipment Rooms (MERs), the Emergency Generator Plant, and additional tenant storage space.

Electrical power for the Subgrades is provided from 2 electrical substations, one in each tower. Because these substations are on Elevation 294' (Level B1), they are designated: Substation 294A in Tower A and 294B in Tower B.

NOTES ON APPENDICES

At the rear of this manual are Appendices A thru D.

Appendix A contains all the figures required to support the text in each chapter. These figures are numbered and presented in the order in which they are first referred to in each chapter.

Appendix B is an alphabetical listing of all the abbreviations in the text and drawings of this manual and their definitions.

Appendix C is a listing of all the symbols in the diagrams of the manual and their definitions.

Appendix D is a cross-reference of the fuse products of popular manufacturers. This cross-reference can be used by maintenance personnel to select an equivalent fuse when the exact replacement is not available.

78 pages

WORLD TRADE CENTER

Instruction Manual No. 12

Operation and Maintenance of

SMOKE DETECTION SYSTEM
OBSERVATION DECK, TOWER B

Final Edition
Engineering Department
Publication, August 1981

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Smoke Detection System, Observation Deck, Tower B, in the World Trade Center.

This manual should be used with, and must comply with, instructions set forth in the "Guide for Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the Smoke Detection System for the Observation Deck located on Floor 107, Tower B, World Trade Center. This manual is divided into 6 chapters.

Chapter 1 is an Introduction to the manual, gives information of a general nature, and deals with power source.

Chapter 2 describes the Smoke Detection Equipment on the 107th floor.

Chapter 3 describes the Smoke Detection Equipment on the 108th floor.

Chapter 4 describes the Smoke Detection Equipment on the 110th floor.

Chapter 5 describes the operation of the Smoke Detection System.

Chapter 6 presents recommendations related to the servicing and testing of the Smoke Detection Equipment.

GENERAL

The Observation Deck is located on Floor 107. The supply, return, and exhaust fans associated with the Observation Deck are located on Floor 108. A First Aid Room on Floor 110 is associated with the Observation Deck. Smoke Detection Equipment is located on 3 floors: 107, 108 and 110. There is a Smoke Detection Control Panel on each of the 3 floors.

POWER SUPPLY

The Smoke Detection Control Panels on Floors 107, 108, and

110 receive 120V A.C., 1Ø, 60 HZ power from circuits 4 and 6 of Panel ERPC-110B, in Closet C, Floor 110, Tower B.

NOTES ON APPENDICES

At the back of this manual are Appendices A, B, C, and D.

Appendix A contains all illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B contains Abbreviations For Text And Drawings.

Appendix C1 contains diagrams relating to the Smoke Detection Equipment on Floor 107.

Appendix C2 contains diagrams relating to the Smoke Detection Equipment on Floor 108.

Appendix C3 contains diagrams relating to the Smoke Detection Equipment on Floor 110.

Appendix D contains Instruction Manual (123-0002), Model NKT-24, *Products of Combustion Detector Tester*.

108 pages

WORLD TRADE CENTER

Instruction Manual No. 13

Operation and Maintenance of

HALON FIRE PROTECTION SYSTEM COMPUTER CENTER, WTC

Final Edition
Engineering Department
Publication, December 1981

THE PORT AUTHORITY OF NY & NJ

FOREWORD

The instructions and recommendations contained in this manual are provided as an aide and guide to all personnel who operate the Computer Center Halon Fire Protection System.

This manual should be used in conjunction with the standard, emergency fire procedures presently in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

PREFACE

To the end that the Computer Center Halon Fire Protection System be properly utilized, it is essential that all personnel concerned be familiar with its operation. This manual provides information and operating instructions so that proper system utilization may be accomplished.

Since the subject matter is vital to all Computer Center personnel, periodic review is strongly recommended.

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CHAPTER 1

INTRODUCTION

SCOPE

The subject of this manual is the Fire Protection System installed in the 70th Floor Computer Center.

Chapter 1 is the Introduction to the manual and contains general information concerning the system and contents of the manual.

Chapter 2 deals with the Fire Detection Subsystem which is part of the integrated Fire Protection System.

Chapter 3 describes the Halon 1301 Extinguishing Subsystem which is also part of the integrated system.

Chapter 4 focuses on the Alarm Subsystem.

Chapter 5 is concerned with all the subsystems as they operate within the integrated Fire Protection System.

Chapter 6 provides the procedures the Floor Warden, Assistant Floor Warden, or their designees should follow to operate the system properly.

Chapter 7 supplies information regarding the maintenance and testing of all the subsystems of the Halon Fire Protection System.

GENERAL

Installed in the 70th Floor Computer Center is a fully automatic Halon Fire Protection System. In actuality, the Fire Protection System is a consolidation of 3 subsystems. They are: the Fire Detection Subsystem, the Alarm Subsystem, and the Halon 1301 Extinguishing Subsystem.

The function of the Halon Fire Protection System is preservation of the extremely expensive computers, equipment, and valuable disk packs and data tapes used in the Computer Center. The extinguishing agent used is Halon 1301 gas which will not damage the equipment. Detailed descriptions of the subsystems and their operation within the integrated Fire Protection System are provided in the chapters that follow.

NOTES ON APPENDICES

Appearing at the rear of this manual is an Appendix. It contains all the illustrations and photos that support the text of each chapter. They are numbered and presented in the sequence in which they are first referred to in the chapters.

ABBREVIATIONS

An alphabetical listing of the abbreviations used in the text and illustrations of this manual and their definitions is provided below:

Abbreviation	*Definition*
A.C.	Alternating Current
Asst.	Assistant
C.D.C.	Control Data Corporation
C.E.	Customer Engineer
DC	Direct Current
I.B.M.	International Business Machines
LHC	Local Halon Control
N.C.R.	National Cash Register
No.	Number
N.Y.C.	New York City
V	Volts

210 pages

WORLD TRADE CENTER

Instruction Manual No. 14

Operation and Maintenance of

DOMESTIC WATER SYSTEM
TOWERS A&B

Final Edition
Engineering Department
Publication, November 1983

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Domestic Water System, Towers A and B, in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The Domestic Water Systems in Towers A and B, World Trade Center, are the subject of this manual. It is divided into 5 chapters.

Chapter 1 is an Introduction. It discusses the scope of the manual.

Chapter 2 describes the Domestic Cold Water System, including the water intake system, the mechanical and electrical controls associated with the pumping stations, and the pressure reducing stations. The fire system makeup and the HVAC makeup are also discussed briefly in Chapter 2.

Chapter 3 describes the Domestic Hot Water System, including the hot water preheaters, the hot water heaters, and the hot water circulating pumps.

Chapter 4 describes the Domestic Water Distribution in the various zones.

Chapter 5 presents the maintenance procedures and schedules for the Domestic Water System.

This manual covers domestic water distribution from Floor 2 thru the roof in each tower. Domestic water distribution on the Concourse Level and the Sublevels will be covered in another manual.

DOMESTIC WATER SYSTEM

The Domestic Water Systems and equipment in Towers A and B are basically similar. A schematic diagram of a Domestic Water System is presented in Figure 1.1. This diagram applies to the Domestic Water Systems in both Towers A and B. The equipment discussed in this manual is in Tower A.

NOTES ON APPENDICES

Appendices A, B, C, D, and E are at the back of this manual.

Appendix A contains all illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B contains the Domestic Water Pump Control Reference.

Appendix C contains the Abbreviations For Text And Drawings.

Appendix D contains the Mechanical Symbols, with explanations.

Appendix E contains the Electrical Symbols, with explanations.

Appendix F contains the References which were used in the preparation of this manual.

330 pages

WORLD TRADE CENTER

Manual No. 15

Operation and Maintenance of

HVAC SYSTEM
TOWERS A&B

Final Edition
Engineering Department
Publication, June 1987

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information in this manual is presented as an aid to all personnel who operate and maintain the Heating, Ventilating, and Air Conditioning System in Towers A and B of the World Trade Center.

This manual should be used with, and must comply with, all Port Authority safety practices and precautions presently in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

PREFACE

The text and diagrams presented in this manual reflect the status of the Heating, Ventilating, and Air Conditioning equipment and controls as they were originally installed in Towers A and B in 1970 under WTC Contracts Nos. 502 and 511.

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CHAPTER 1

INTRODUCTION

SCOPE

The Heating, Ventilating, and Air Conditioning (HVAC) System in Towers A and B of the World Trade Center (WTC) is the subject of this manual. The system is described as it was at the time of original installation.

Chapter 1 is the Introduction to the manual. The chapter contains descriptions of the general layouts of Towers A and B and the locations of the Mechanical Equipment Rooms in the towers. Also in the chapter is general information regarding: the types of air conditioning systems in the towers, the chilled water that cools the towers, and the steam that is the primary source of heat for the Trade Center.

Chapter 2 describes the steam supply to the towers and its distribution to the HVAC System.

Chapter 3 focuses on the Chilled Water Distribution System in the towers and the locations of the quick-fill and drain valves.

Chapter 4 describes the various categories of HVAC Systems and units in the towers and includes information regarding their return air and exhaust fans. The chapter also contains information regarding the Central Control System in the Trade Center.

Chapter 5 deals with the system that supplies heated water to the reheat coils in the supply ducts of the Interior Air Conditioning System.

Chapter 6 covers the Secondary Water System that provides hot and cold water for the Peripheral Air Conditioning Systems in the towers.

Chapter 7 deals with the methods by which air from the various categories of HVAC units is discharged on each floor of the towers. The chapter also describes how air is returned to the HVAC units or exhausted from the towers.

GENERAL

The HVAC design for the towers of the World Trade Center, for the most part, is traditional. After chilled water from a Central Refrigeration Plant and steam, purchased from Con Edison, are piped to a Mechanical Equipment Room (MER), both are distributed to the HVAC equipment in the same manner as in most large buildings requiring an MER of similar capacity. This system is repeated 4 times in each tower, as each tower can be considered to be 4 buildings in one, each building one above the other, and each having one MER. See Figure 1.1.

CHILLED WATER PLANT AND DISTRIBUTION SYSTEM

A Central Refrigeration Plant, located on Levels B4, B5, and B6, approximately midway between Towers A and B, produces chilled water. This chilled water is used to cool all the buildings in the

251 pages

WORLD TRADE CENTER

Instruction Manual No. 16

Operation and Maintenance of

ELECTRICAL AND MECHANICAL SYSTEMS CLUB/RESTAURANT

FOR REVIEW ONLY

Engineering Department
Publication, March 1985

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Electrical and Mechanical Systems for the Club/Restaurant at the World Trade Center.

This manual should be used with, and must comply with, the instructions set forth in the "Guide For Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division , Engineering Department, with the cooperation of the Operations Division of the World Trade Department.

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MANUFACTURERS' SPECIFICATIONS DATA

CHAPTER 1

INTRODUCTION

SCOPE

The electromechanical systems of the WTC Club/Restaurant are covered in this Manual. The electrical system discusses the power source to and its distribution within the area of the Club/Restaurant. The mechanical system is associated with the heating, ventilating, and air conditioning of the Club/Restaurant.

Chapter 1 is an introduction to the electrical and mechanical systems of the Club/Restaurant.

Chapter 2 discusses the electrical power distribution.

Chapter 3 describes the Smoke Detection System in the ceiling and ductwork.

Chapter 4 covers the Fire Extinguishing System in the exhaust hoods in the kitchen area.

Chapter 5 describes the Intrusion Alarm Control System.

Chapter 6 discusses the HVAC System and completely describes its operational aspects.

GENERAL

The Club/Restaurant of the WTC is on the 107th floor of Tower A (North Tower). In addition to describing the electrical source and distribution of the power of the Club/Restaurant, coverage is

also given to its security aspects and its fire protection systems. See Figures 1.1 and 1.2.

The HVAC system's equipment and controls are in the 108th floor MER. An outdoor master thermostat is outside the MER, in the northeast corner of the parapet. This thermostat controls the HVAC system's operations. See Figures 1.3 and 1.4. From the 108th floor MER air is moved to service the Club/Restaurant complex, which occupies the 106th and 107th floors. The HVAC units are known as 4-wall peripheral units.

In addition to these HVAC units in the 108th floor MER, the Club/Restaurant is provided with terminal reheat units to augment heating of specific spaces if necessary. The source of the heat is the interior reheat hot water system. The interior reheat units are in the ceilings of the 106th and 107th floors. These units require separate controls in the form of wall-mounted thermostats.

For proper ventilation of the Club/Restaurant, efficient exhaust systems are necessary in both the Restaurant area and the kitchen area. There are several exhaust units to service the Restaurant area. These units are in the 108th floor MER. The kitchen exhaust units have fire protective devices. These exhaust units are Gaylord Hood Exhaust Systems and they are also in the 108th Floor MER.

To achieve proper circulation of air in the various rooms, transfer fans are necessary in the Club/Restaurant. There are several such fans in the ceiling of the Club/Restaurant.

WTCI-5-P

247 pages

WORLD TRADE CENTER

Instruction Manual No. 17

Operation and Maintenance of

HVAC SYSTEM
SUBGRADE LEVELS

FOR REVIEW ONLY

Engineering Department
Publication, February 1985

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Heating, Ventilating, and Air Conditioning System for the Subgrades at the World Trade Center.

This manual should be used with, and must comply with, the instructions set forth in the "Guide For Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

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MANUFACTURERS' SPECIFICATIONS DATA

CHAPTER 1

INTRODUCTION

SCOPE

The HVAC System of the WTC subgrades is independent of the HVAC System of the WTC towers. Therefore 2 separate manuals have been prepared: WTC O&M Manual No. 15, "HVAC Systems, Towers A & B"; and this manual.

This manual describes the equipment and sequential operations of the HVAC air handling units in the subgrades. In addition, the steam and chilled water distribution systems as well as the metering setup for steam consumption are described.

Chapter 1 is an outline of the information in this manual and a general description of the HVAC System.

Chapter 2 describes the distribution of the chilled water supply and return systems.

Chapter 3 discusses the steam distribution system from the Steam Meter Room (SMR). The steam from this room serves the subgrades and the towers.

Chapter 4 describes the areas served by the HVAC equipment in the Mechanical Equipment Rooms (MERs). In addition, selected data are provided for the more important air handling equipment.

Chapter 5 discusses the controls and sequential operations for the air handling equipment. Maintenance procedures for the equipment and systems troubleshooting are also provided.

GENERAL

Heating, ventilating, and air conditioning of the subgrades in the WTC are provided via air handling equipment located mainly in the MERs on Level B6 (El. 242') in both Tower A and Tower B.

The chilled water that flows to the chilled water coils of the equipment comes from the Refrigeration Plant. (See WTC O&M Manuals Nos. 3 and 4.) The steam is supplied by Con Edison and is metered at the SMR before being distributed to the reheat and preheat coils of the air handling equipment.

NOTES ON APPENDICES

Appendices A through E are at the back of this manual.

Appendix A contains all the illustrations that support the text in each chapter. The illustrations are presented and numbered in the sequence in which they are first referred to.

Appendix B is an alphabetical listing, with definitions, of the abbreviations or designations in the text and illustrations of this manual.

Appendix C is a listing, with definitions, of the electrical and mechanical symbols in the diagrams.

Appendix D lists all the relevant reference information used in compiling this manual.

Appendix E shows the relationships between the sublevels and elevations of the WTC complex.

Behind Appendix E is a compilation of the Manufacturers' Specifications Data related to the equipment and devices in this HVAC System.

WTCI-5-P

165 pages

WORLD TRADE CENTER

Manual No. 18

Operation and Maintenance

FIRE SPRINKLER SYSTEMS

FINAL REVIEW

Engineering Department
Publication, April 1987

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Fire Sprinkler Systems in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The Fire Sprinkler Systems of the World Trade Center are the subject of this manual. It is divided into 8 chapters.

Chapter 1 is an Introduction to the manual and discusses the valve designation system.

Chapter 2 describes the sprinkler water distribution loops.

Chapter 3 describes the sprinkler fire pumps.

Chapter 4 describes the sprinkler systems in the Southeast Plaza Building.

Chapter 5 describes the sprinkler systems in the Northeast Plaza Building.

Chapter 6 describes the sprinkler systems in the subgrade and sublevel areas associated with Towers A & B.

Chapter 7 describes the sprinkler systems in Towers A and B.

Chapter 8 describes the different types of sprinkler heads installed in various locations of the WTC complex.

GENERAL

There are 2 major sprinkler systems: one system serves the SEPB, the NEPB, and the subgrades and sublevels of Towers A and B; the other system serves most of the floors (1 thru 110) in Towers A and B.

SPRINKLER SYSTEMS

General

The function of the sprinkler systems is the automatic discharge of water in sufficient density to control or extinguish a fire at its very beginning, before significant damage can be done, and before public or private firefighters can possibly be on the scene.

Wet Pipe System

The sprinkler systems at the World Trade Center are the Wet Pipe type. The Wet Pipe system employs automatic sprinklers attached to pipes containing water under pressure at all times. When fire occurs, affected individual sprinklers are actuated by the heat, and they immediately release a dense spray of water. Being that there is no danger of the water freezing inside the pipes, the Wet Pipe system is used at the World Trade Center.

Sprinklers

The sprinklers are designed to spray a blanket of water over the immediate fire area. The sprinklers provide a uniform water distribution pattern, thus assuring fire-affected areas are provided with complete coverage. Random scattering of water with

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20

Instructions & Procedures

elevator system

WORLD TRADE CENTER

Manual No. 20

Instructions & Procedures

ELEVATOR SYSTEM

Final Edition
Engineering Department
Publication, October 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and procedures in this manual are presented to aid Port Authority personnel in the operations of both passenger and freight elevators at the World Trade Center during normal and emergency situations.

The manual must be used with, and must comply with, instructions in the "Guide For Port Authority Electricians", O & M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the Operations Division, World Trade Center, and the Otis Elevator staff.

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CHAPTER I

INTRODUCTION

SCOPE

Operational procedures for the Passenger And Freight Elevator System at the WTC during normal and emergency situations are documented in this manual.

Chapter 1 provides a general description of the system: the types of elevators in use, the Elevator Machine Rooms, and the Motor-Generator Rooms.

Chapter 2 describes the Normal Operation of the elevator system and the normal power distribution to the elevators.

Chapter 3 covers the Emergency Operation of the elevator system and the emergency power distribution to the elevators.

Chapter 4 discusses unusual conditions (e.g., high winds resulting in excessive swaying of the towers) and the special procedures necessary to safely operate the elevators under these conditions. The use of elevators during a fire emergency is also described.

Chapter 5 describes the Electrical Control System: its equipment, control panels, and visual and audible indication alarms. The chapter concludes with a description of the communication system within the elevator network.

GENERAL DESCRIPTION

Overview

Approximately 250 elevators operate in the WTC, of which about 200 are in Towers A and B. The elevators in the WTC are 3 basic types: passenger elevators, freight or service elevators (including Fire Department elevators), and combination elevators (which can be used for both passenger and freight service).

Groups of shuttle and bank elevators are provided with Elevator Machine Rooms (EMRs) and Motor-Generator Rooms (MGRs), generally located below the EMRs. The Elevator Pit (EP) is from 1 to 3 floors below the lower limit of the elevator run.

The elevators in the towers which provide express runs from the Concourse to the 44th and 78th Floor Skylobbies are called shuttle elevators. Local or bank elevators service the floors between the Concourse and the 2 skylobbies. See Figures 1.1 thru 1.6. The elevators are monitored by Elevator Starter Panels (ESPs) located on the Concourse (for all shuttle elevators, including Elevators Nos. 6 and 7) and the 44th and 78th Floor Skylobbies.

Elevator Machine Rooms

See Figures 1.1 thru 1.6. The shuttle EMRs have 2 floors. The upper floors house the DC motors, imaging cages, and controls. The lower floors house the elevator governors.

The bank EMRs have only 1 level and house the DC motors, imaging cages, AC switchgear, and controls.

Motor-Generator Rooms

See Figures 1.7 thru 1.11. The shuttle elevator MGRs are on 1 level, on which are the motor-generator sets, the motor-generator starters, and the AC switchgear. The motor-generator sets convert the AC power to DC. This DC power is distributed to the EMRs.

The bank elevator MGRs, consisting of an upper and a lower level, are on 1 floor. The bank elevator governors are on the upper level; the motor-generator sets are on the lower level.

The bank elevator MGRs are 1 floor directly below the EMRs. However, the shuttle elevator MGRs are not either directly or 1 floor below the EMRs. The shuttle elevator MGRs are: on the 41st floor for Elevators Nos. 1-5 and 8-11; on the 75th floor for Elevators Nos. 18-23; on the 76th floor for Elevators Nos. 12-17; and on the 110th for Elevators Nos. 6 and 7.

Elevator Pit

The Elevator Pit (EP) houses the blocking supports, the compensation sheaves, and the tie-down beams. The EPs for the shuttle elevators occupy between 2 and 4 floors below the lower limits of the elevator runs, whereas the (EPs) for the bank elevators occupy only 1 or 2 floors below the lower limits of the elevator runs. See Figures 1.1 thru 1.6 and 1.12.

WORLD TRADE CENTER

Manual No. 21

Operation and Maintenance

ANTENNA HEATING SYSTEM
TOWER A

Final Edition
Engineering Department
Publication, December 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations contained in this manual are presented as an aid and guide to all personnel who operate and maintain the Antenna Heating System, Tower A, World Trade Center.

This manual should be used with, and must comply with, the instructions set forth in the "Guide For Port Authority Electricians", O&M Standards, and other approved safety procedures in effect at the World Trade Center.

The contents of this manual have been researched, compiled and prepared by the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the Operations Division of the World Trade Center.

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CHAPTER 1

INTRODUCTION

SCOPE

The heating and ventilating systems for the antenna housing on the roof of Tower A are described in this manual. The antenna's interior space is heated by both electrical and mechanical methods to ensure reliability of the system.

Chapter I provides an Introduction outlining the need for heating the antenna housing.

Chapter 2 describes: the steam distribution system; the associated piping run pertaining to the heating of the antenna's interior: and the mechanical equipment and control devices.

Chaper 3 covers: the distribution of electrical power to the heating system; the electrical heating process; and the electrical equipment and control devices.

Chapter 4 gives a description of the 4 heating stages designed to maintain a temperature of 74 degrees F inside the antenna. In addition, the control alarm and monitoring systems associated with the heating cycles are described.

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WORLD TRADE CENTER

Manual No. 22

Operation and Maintenance

COMPRESSED AIR SYSTEM

FOR REVIEW ONLY

Engineering Department
Publication, August 1988

THE PORT AUTHORITY OF NY & NJ

FOREWORD

The instructions and recommendations in this manual are presented to aid and guide Port Authority personnel who operate and maintain the Compressed Air System in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory personnel.

The contents of this instruction manual have been researched, compiled, and prepared by the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The Electromechanical Systems associated with the production and delivery of compressed air between 80-190 PSI for all pneumatic control devices at the WTC, and for cleaning purposes, are described in this manual.

Chapter 1 provides a general description of the system and the locations of the equipment.

Chapter 2 describes the mechanical equipment.

Chapter 3 discusses the electromechanical control and alarm devices and their modes of operation.

Chapter 4 focuses on the sequential operation of the compressed air cycle. A troubleshooting procedure for system malfunction is also in this chapter.

Chapter 5 describes the electrical system and equipment for the Compressed Air System. Normal and emergency power for this system are outlined and the electrical equipment ia described.

Maintenance schedules are in the chapters where equipment and devices are described.

Chapter 8 covers the Spinkler System installed in all buildings and Subgrades of the Trade Center.

Chapter 9 provides information regarding the Sprinkler Waterflow Alarm System installed in the Subgrades of the Trade Center.

Chapter 10 deals with the Fire Standpipe System and hoses used throughout the Trade Center.

Chapter 11 discusses the Fire Pumps in the Sprinkler and Fire Standpipe Systems.

Chapter 12 deals with the Standpipe Fireline Communication System in the Trade Center.

Chapter 13 contains the procedures WTC Operations personnel should use to purge smoke from certain areas in the Trade Center after a fire has been extinguished.

In addition, all chapters contain inspection, testing, and maintenance requirements and procedures.

NOTES ON APPENDICES

Appearing at the back of this manual are the following appendices.

Appendix A contains the photographs and drawings that support the text in the chapters of the manual. The photographs and drawings are numbered and presented in the order in which they are first referred to in the chapters.

Appendix B comprises the abbreviations used in the text and illustrations of the manual.

WORLD TRADE CENTER

Instruction Manual No. 25

Operation and Maintenance of

SEWAGE AND SUMP SYSTEMS SUBLEVELS, TOWERS A & B

Final Edition
Engineering Department
Publication, August 1985

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the sewage and sump systems located below grade of Towers A and B (including areas J and K), in the World Trade Center, New York, New York.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by the plant supervisory staff.

The contents of this instruction manual have been researched, compiled and prepared by Syska & Hennessy, New York, with the cooperation of the World Trade Center Maintenance Methods Section of the Design Division for Maintenance Engineering, Engineering Department and the Operating Maintenance Staff of the World Trade Center.

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CHAPTER 1

INTRODUCTION

SCOPE

The subjects of this manual are the sub-level sewage systems and the sub-level sump systems for Towers A and B (including areas J and K), of the World Trade Center.

Chapter 1 is an Introduction, which includes the scope of the manual.

Chapter 2 describes the sub-level sewage systems, including the pumping stations and their mechanical and electrical controls.

Chapter 3 describes the sump systems including the pumping stations and their mechanical and electrical controls.

SEWAGE SYSTEMS

Since sewage is collected by gravity from areas of the World Trade Center which are located below the city gravity sewers, six sewage systems have been installed. These six sewage systems consist of sewage pits located at Level B-6, and two sewage ejector pumps located

WORLD TRADE CENTER

Manual No. 27

Operation and Maintenance

DOMESTIC WATER SYSTEM

NEPB

FOR REVIEW ONLY

Engineering Department
Publication, June 1988

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Domestic Water System, NEPB, in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The Domestic Water System in the NEPB is described in this manual. It is divided into 5 chapters.

Chapter 1 is the Introduction. It discusses the scope of the manual and describes the water supply to the NEPB. This chapter also provides a diagram showing the layout of the Domestic Water System equipment in the Mechanical Equipment Room (MER), Elevation 289'6", NEPB. The Notes On Appendices are in this chapter.

Chapter 2 describes the Domestic Cold Water System, including the: water meter, pumps, pump motors, motor controllers, low- and high-pressure switches, pressure-electric transducers, air cushion tank, and air compressor. This chapter also discusses the operation of the pump control system.

Chapter 3 describes the Domestic Hot Water System, including the preheater, hot water heaters, and hot water circulating pumps.

Chapter 4 describes the Domestic Water Distribution System in the NEPB. It provides a riser diagram showing the Domestic Water System equipment in the MER, the cold water, the hot water, and the hot water circulating lines. This chapter also contains diagrams showing the locations of isolation valves associated with:

the cold water, the hot water, and hot water circulating risers. These diagrams show the isolation valves for the tenant areas.

Chapter 5 presents the maintenance procedures and schedules for the domestic water equipment.

WATER SUPPLY

The Domestic Water System in the NEPB receives its water supply from the New York City Water System via a utility rack, which passes through the truck dock area. This utility rack extends from the northeast corner of Tower A to the southeast corner of Tower B. At both extremes of the rack are valves that can be used to isolate the rack from the street source. Water can be supplied to the system from either end of the rack. In the event one valve is closed, the system receives water from the other end.

NOTES ON APPENDICES

Appendices A,B,C,D,E, and F are at the end of this manual.

Appendix A contains all the illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B contains the Domestic Water Pump Control Reference.

Appendix C contains the Abbrevations For Text And Drawings.

Appendix D contains the Mechanical Symbols, with explanations.

Appendix E contains the Electrical Symbols, with explanations.

Appendix F contains the References which were used in the preparation of the manual.

WTCI-5-P

181 pages

WORLD TRADE CENTER

Manual No. 31

Operation and Maintenance

WINDOW WASHER AND EXTERIOR PLATFORM EQUIPMENT

TOWERS A AND B

Engineering Department
Publication, June 2000

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel, who operate and maintain the Window Washer and Exterior Platform Equipment associated with Towers A & B of the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures, as well as with instructions provided by plant supervisory staff.

The contents of this manual have been researched, organized and prepared by the Technical Manuals Group of the Maintenance Engineering Design Division, Engineering Department, The Port Authority of New York and New Jersey.

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CHAPTER 1

INTRODUCTION

SCOPE

The Window Washer and the Exterior Platform Equipment associated with Towers A and B of the World Trade Center are the subject of this manual. The manual is divided into 8 chapters.

Chapter 1 is the Introduction to the manual. It briefly describes the entire system.

Chapter 2 describes the Roof Car.

Chapter 3 deals with the Automatic Window Washer.

Chapter 4 focuses on the Maintenance Platform.

Chapter 5 discusses the Roof Track System.

Chapter 6 describes the Roof Car Transfer Platform System.

Chapter 7 contains Maintenance and Inspection Schedules and Procedures.

Chapter 8 deals with the Electrical Power Distribution System.

GENERAL

On each tower the equipment consists of a Roof Car, an Automatic Window Washer, a Maintenance Platform, a Roof Track System, a Roof Car Transfer Platform System and garage, and Guideways in the columns in the tower's exterior walls. See Figures 1.1, 1.2, and 1.3.

The primary function of the Roof Car is to transport the Window Washer and Maintenance Platform horizontally on the roof and raise and lower them along the sides of the building in order to wash and maintain the windows and exterior surfaces of the building.

The Roof Car supports a Positioning System and two independent Hoisting systems. The Positioning System consists of an Outrigger, hinge-mounted at its inboard end to the Roof Car and at its outboard end, supporting a framework of four Launch Guides. See Figure 1.1.

The Window Washer is carried on the two inner Launch Guides and the Maintenance Platform on the two outer Launch Guides. Before a descent begins, the positioning system is lowered by a pair of hydraulic cylinders, so that the Launch Guides line up with the building Guideways.

An Indexing Pin on the lower end of each Launch Guide mechanically interlocks with an indexing stirrup behind each Guideway, thus ensuring alignment for the guide wheel assemblies on the Window Washer and Maintenance Platform to properly enter the Guideways on the building. After a wash cycle has been completed, the Positioning System must be

raised at least one foot so that the Roof Car can be moved to the next bay.

There are two separate Hoist Systems in the Roof Car: one for the Window Washer and the other for the Maintenance Platform. They operate independently of each other so that the Window Washer and Maintenance Platform can be used at the same time. The Maintenance Platform is designed so that the Window Washer can pass through it, if necessary.

The Roof Car, carrying the Window Washer and Maintenance Platform, moves horizontally along the roof on a track system installed on the roof. The track system includes a turntable at each corner of the building, such that the Roof Car can be turned 45 degrees for cleaning the corner, and an additional 45 degrees to proceed along the next wall.

When not in use, the Roof Car and its components are stored in the system garage on the 110th floor. A Transfer Platform is used to raise the Roof Car from the garage to the roof and lower it from the roof to the garage.

Note: In this manual the terms "left side of the Roof Car" and "right side of the Roof Car" refer to those sides of the Roof Car that are on the Roof Car Operator's left and right, respectively, when the front of the Roof Car is parallel with a side of the building and the Roof Car Operator is on the Control Platform facing that side of the building.

WTCI-5-P

WORLD TRADE CENTER

Manual No. 32

Operation and Maintenance

WINDOW WASHING AND EXTERIOR WALL MAINTENANCE SYSTEMS SEPB AND NEPB

Final Edition
Engineering Department
Publication, December 1992

THE PORT AUTHORITY OF NY & NJ

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

MEMORANDUM

TO: Thomas Cancelliere, Manager, Plant and Structures, WTC
FROM: Joseph DiSorbo
DATE: February 26, 1993
SUBJECT: **OPERATION AND MAINTENANCE MANUAL NO. 32, WINDOW WASHING AND EXTERIOR WALL MAINTENANCE SYSTEMS - SEPB AND NEPB**

COPY TO: J. Ansley, E. Auerbach, A. Brociner, J. Buchsbaum, S. Burrick, J. Castaldo, D. Chaudhuri, S. Knapp, R. Kriegel, E. Piccinich, A. Reiss, N. Spector, T. Stam, G. Tong, S. Wiener

Operation and Maintenance Manual No. 32, "Window Washing And Exterior Wall Maintenance Systems - SEPB And NEPB" was prepared under the direction of the Technical Manuals Group of the Maintenance Engineering Design Division at the request of the World Trade Department.

The manual provides operation and maintenance information and procedures, drawings, and photographs to aid the maintenance and technical staffs at the World Trade Center. We wish to thank World Trade Center personnel for their aid and cooperation during the development of the manual.

Preparation of the manual was directed by Mort Zeigen of the Technical Manauals Group. We are sending 20 copies of the manual to you for your use and distribution. If you have any questions regarding the manual, call Mort Zeigen at the Tech Center, (201) 216-2559.

Joseph DiSorbo, P.E.
Engineering Program Manager
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F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel, who operate and maintain the Window Washer And Exterior Platform Equipment associated with the Southeast and Northeast Plaza Buildings of the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures, as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by Burns and Roe Industrial Services Company, New Jersey under the direction of the Technical Manuals Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the Operations Division of the World Trade Center.

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APPENDIX F . . . . . Manufacturers' Information

CHAPTER 1

INTRODUCTION

SCOPE

The Window Washing and Exterior Wall Maintenance Systems of the Southeast (Building No.4) and Northeast (Building No.5) Plaza Buildings of the World Trade Center are the subject of this manual. The manual is divided into 8 chapters.

Chapter 1 is an Introduction to the manual and describes the systems.

Chapter 2 describes the Roof Cars.

Chapter 3 focuses on the Maintenance Platforms.

Chapter 4 discusses the Roof Track Systems.

Chapter 5 deals with System Operating Procedures.

Chapter 6 discusses the Electrical Power Distribution Systems.

Chapter 7 deals with Maintenance.

Chapter 8 describes troubleshooting procedures.

EQUIPMENT DESCRIPTION

The equipment on each building consists of a Roof Car, a Maintenance Platform, an Outrigger and a Roof Track. These components are shown in Figure 1.1.

The primary function of the Roof Car is to transport the Maintenance Platform along the Roof Track System and raise or lower the Maintenance Platform to provide access to the windows and exterior surfaces of the building. The Roof Car supports a positioning system and an independent hoisting system. See Figure 1.1.

The positioning system consists of an Outrigger which is mounted on the Roof Car. Before a descent begins, the Maintenance Platform is moved over the building parapet to the face of the building by the Outrigger, so that the Face Rollers on the Maintenance Platform have continuous contact with the face of the building. After a cycle has been completed, the Platform must be lifted at least one foot above the parapet before it can be moved to the next section, and must be lifted as far as possible to clear the corners of the building.

The Hoist System incorporates two hoisting drums for the platform cables and an associated motor and gearbox.

The Roof Car, carrying the Maintenance Platform, moves horizontally on a track system installed on the roof. The track system includes a curved section at each corner of the building, so that the Roof Car can be positioned for cleaning the corner, and proceed along the next wall.

When not in use, the Roof Car and Maintenance Platform are stored on the roof.

WARNING

THIS EQUIPMENT SHOULD NOT BE USED WHEN
THERE ARE GUSTY WINDS, ELECTRICAL STORMS,
OR OTHER SEVERE WEATHER CONDITIONS.

NOTES ON APPENDICES

At the back of this manual are Appendices A thru F.

Appendix A contains all the illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B lists the abbreviations used in the text along with their definitions.

Appendix C contains the abbreviations used in the illustrations and their definitions.

Appendix D contains the electrical symbols used in the illustrations along with their definitions.

Appendix E is the list of references used in the preparation of the manual.

Appendix F contains manufacturers' information.

494 pages

WORLD TRADE CENTER

Manual No. 33

Operation and Maintenance

COMPUTER COOLING WATER SYSTEM

TOWERS A AND B

Final Edition
Engineering Department
Publication, August 1996

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information in this manual is presented to aid and guide Port Authority personnel who operate and maintain the Computer Cooling Water System in Towers A and B of the World Trade Center (WTC).

Operating and maintenance personnel must comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory personnel.

The contents of this manual have been researched, compiled, and prepared by DCI Technical Inc. and the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the mechanical maintenance staff at the WTC.

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CHAPTER 1

INTRODUCTION

SCOPE

The Computer Cooling Water System in Towers A and B of the World Trade Center (WTC) is the subject of this manual.

Chapter 1 is the introduction to the manual. Contained in the chapter is general information regarding the various systems used to provide computer cooling water to Towers A and B.

Chapter 2 describes River Water Input System A and the components that comprise the system.

Chapter 3 describes River Water Input System B and the components that comprise the system.

Chapter 4 describes the Computer Cooling Water Systems (Systems Nos. 1, 1A, and 2) of Tower A and the components that comprise each of the systems.

Chapter 5 describes the Computer Cooling Water Systems (Systems Nos. 5, 7, 8, and 9) of Tower B and the components that comprise each of the systems.

Chapter 6 contains the inspection and maintenance tasks which are required at periodic intervals for all systems listed above. Inspection and routine maintenance rosters are specified. Maintenance Procedure Cards (MPCs) are also included.

Chapter 7 contains troubleshooting procedures to aid maintenance personnel in isolating and correcting a malfunction in the Computer Cooling Water System.

GENERAL

The Computer Cooling Water System provides the WTC with a monitored water supply at a constant temperature. This water is used in the condensers of packaged air conditioners utilized by the tenants of the WTC for computer cooling purposes.

There are ten individual systems which provide computer cooling water to the WTC buildings. Systems Nos. 1, 1A, 2, 5, 7, 8, and 9, with River Water Input Systems A and B, provide computer cooling water to Towers A and B. These systems are described in this manual. See Figures 1.1-A and 1.1-B.

Systems Nos. 3, 4, 6 and 10 provide computer cooling water to the Subgrades, Concourse, Northeast Plaza Building (NEPB), and Southeast Plaza Building (SEPB). For more information on these systems, refer to WTC Operation & Maintenance Manual No. 34, "Computer Cooling Water System, Northeast and Southeast Plaza Buildings, World Trade Center." See Figures 1.1-A and 1.1-B.

RIVER WATER INPUT SYSTEMS

River Water Input Systems A and B provide river water to be used by the parent systems. The parent systems are considered to be Systems Nos. 1, 3, and 7. These systems utilize

river water to provide computer cooling water to tenants in various locations within the WTC complex.

TOWER A

System No. 1

System No. 1 is a parent (primary) system. In addition to providing computer cooling water to tenants on Floors 10 through 43 of Tower A, System No. 1 provides the auxiliary cooling water which feeds System No. 2. The auxiliary cooling water is cooled using river water supplied by River Water Input System A. When necessary, chilled water from the Chilled Water System is used to provide additional cooling capacity. In addition, when RW and the chilled water systems are not providing sufficient cooled water, a backup emergency domestic water supply is used. For information on the Chilled Water System, refer to WTC Operation and Maintenance Manual No. 3, "Mechanical Systems, Central Refrigeration Plant, World Trade Center" and WTC Operation and Maintenance Manual No. 4, "Electrical Systems, Central Refrigeration Plant, World Trade Center."

System No. 1A

System No. 1A is part of System No. 1. System No. 1A provides System No. 2 with auxiliary cooling water from System No. 1. System No. 1A is basically an additional set of supply and return risers supplying computer cooling water to Floors 10 through 40 and to the mechanical equipment room on the 43rd floor.

System No. 2

System No. 2 is a child (secondary) system. It provides computer cooling water to tenants on Floors 45 through 107 of Tower A. The computer cooling water is cooled using the auxiliary cooling water from Systems Nos. 1 and 1A.

TOWER B

System No. 5

System No. 5 is a child (secondary) system. It provides computer cooling water to tenants on Floors 14 through 24 of Tower B. The computer cooling water is cooled using the auxiliary cooling water supplied by System No. 3.

System No. 7

System No. 7 is a parent (primary) system. In addition to providing computer cooling water to tenants on Floors 5 through 40 of Tower B, System No. 7 provides the auxiliary cooling water which feeds System No. 8. When necessary, chilled water from the Chilled Water System is used to provide additional cooling capacity. For information on the Chilled Water System, refer to WTC Operation and Maintenance Manual No. 3, "Mechanical Systems, Central Refrigeration Plant, World Trade Center" and WTC Operation and Maintenance Manual No. 4, "Electrical Systems, Central Refrigeration Plant, World Trade Center." System No. 7A, which is also part of system No. 7 is primarily used for summer operation.

System No. 8

System No. 8 is a child (secondary) system. In addition to providing computer cooling water to tenants on Floors 44 through 75 of Tower B, System No. 8 also provides the auxiliary cooling water which feeds System No. 9.

System No. 9

System No. 9 is a tertiary system that provides computer cooling water to tenants on Floors 78 through 99 of Tower B. The computer cooling water is cooled using the auxiliary cooling water from System No. 8.

INSPECTION AND MAINTENANCE

Inspection and Maintenance requirements for the components of the Computer Cooling Water System are provided in the form of roster routines and MPCs. These cards outline the appropriate maintenance tasks to be performed.

TROUBLESHOOTING

Troubleshooting procedures are provided in a tabular format which includes: Troubles, their Probable Cause(s), and the Corrective Action(s) required to remedy the trouble(s).

NOTES ON APPENDICES

Appendices A through H are located at the rear of this manual.

Appendix A contains all the diagrams and photographs required to support the text in each chapter. The illustra-

tions are numbered and presented in the order in which they are first referred to.

Appendix B is an alphabetical listing, with definitions, of the abbreviations and designations used in the text and photos of the manual.

Appendix C is an alphabetical listing, with definitions, of the abbreviations and designations used in the drawings of this manual.

Appendix D is a listing, with definitions, of the mechanical symbols used in the diagrams of this manual.

Appendix E is a listing, with definitions, of the electrical symbols used in the diagrams of this manual.

Appendix F is a list of the references (drawings and publications) used in the preparation of this manual. These references should be utilized to obtain additional detailed information regarding specific components in the system.

Appendix G is a diagram of the World Trade Center Floor Level Cross-Reference.

Appendix H contains the Manufacturers' Information related to the equipment and components in the Computer Cooling Water System.

WTCI-5-P

WORLD TRADE CENTER

Manual No. 34

Operation and Maintenance

COMPUTER COOLING WATER SYSTEM NORTHEAST AND SOUTHEAST PLAZA BUILDINGS

Final Edition
Engineering Department
Publication, August 1994

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information in this manual is presented to aid and guide Port Authority personnel who operate and maintain the Computer Cooling Water System in the Subgrades, Concourse, Northeast Plaza Building (NEPB), and Southeast Plaza Building (SEPB) of the World Trade Center (WTC).

Operating and maintenance personnel must comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory personnel.

The contents of this manual have been researched, compiled, and prepared by DCI Technical Inc., and the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the mechanical maintenance staff at the WTC.

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CHAPTER 1

INTRODUCTION

SCOPE

The Computer Cooling Water System (Systems Nos. 3, 4, 6, and 10) in the Subgrades, Concourse, Northeast Plaza Building (NEPB), and Southeast Plaza Building (SEPB) of the World Trade Center (WTC) is the subject of this manual.

Chapter 1 is the introduction to the manual. Contained in the chapter is general information regarding the various systems used to provide computer cooling water to the Subgrades, Concourse, NEPB, and SEPB.

Chapter 2 describes System No. 3 and the components that comprise the system. System No. 3 provides computer cooling water to the Subgrades and Concourse.

Chapter 3 describes Systems Nos. 4 and 10 and the components that comprise each of the systems. Systems Nos. 4 and 10 provide computer cooling water to the NEPB.

Chapter 4 describes System No. 6 and the components that comprise the system. System No. 6 provides computer cooling water to the SEPB.

Chapter 5 contains the inspection and maintenance tasks which are required at periodic intervals for all systems listed above. Inspection and routine maintenance rosters are specified. Maintenance Procedure Cards (MPCs) are also included.

Chapter 6 contains troubleshooting procedures to aid maintenance personnel in isolating and correcting malfunctions in the Computer Cooling Water System.

GENERAL

The Computer Cooling Water System provides the WTC with a monitored water supply at a constant temperature. This water is used predominantly in the condensers of packaged air conditioners utilized by the tenants of the WTC for computer cooling purposes.

NOTE

Computer cooling water has also been referred to as auxiliary cooling water (ACW). The piping and equipment in the Computer Cooling Water System carry the designation ACW. For this reason, computer cooling water will also be referred to as auxiliary cooling water or ACW in this manual.

There are ten individual systems which provide computer cooling water to the WTC buildings. Systems Nos. 1, 2, 5, 7, 8, and 9, with River Water Input Systems A and B, provide computer cooling water to Towers A and B. For information on these systems, refer to WTC Operation & Maintenance Manual No. 33, "Computer Cooling Water System, Towers A & B, World Trade Center." See Figure 1.1.

Systems Nos. 3, 4, 6, and 10 provide computer cooling water to the Subgrades, Concourse, NEPB, and SEPB. These systems are described in this manual. See Figure 1.1.

SUBGRADES AND CONCOURSE

System No. 3

System No. 3 is a parent system. In addition to providing computer cooling water to the Subgrades and Concourse, System No. 3 provides the water which cools Systems Nos. 4, 5, and 6. The ACW from System No. 3 is cooled by river water supplied by River Water Input System A. When necessary, chilled water from the Chilled Water System is used to provide additional cooling capacity. For information on the Chilled Water System, refer to WTC Operation and Maintenance Manual No. 3, "Mechanical Systems, Central Refrigeration Plant, World Trade Center" and WTC Operation and Maintenance Manual No. 4, "Electrical Systems, Central Refrigeration Plant, World Trade Center."

NORTHEAST PLAZA BUILDING

System No. 4

System No. 4 is a child system of System No. 3. It provides computer cooling water to the NEPB. The computer cooling water is cooled by cooling water supplied by System No. 3.

System No. 10 (Dean Witter Reynolds)

System No. 10 is an independent computer cooling system. It uses a glycol solution to provide computer cooling for Dean Witter Reynolds in the NEPB.

SOUTHEAST PLAZA BUILDING

System No. 6

System No. 6 is a child system of System No. 3. It provides computer cooling water to the SEPB. The computer cooling water is cooled by cooling water supplied by System No. 3.

INSPECTION AND MAINTENANCE

Inspection and Maintenance requirements for the components of the Computer Cooling Water System are provided in the form of roster routines and MPCs. These cards outline the appropriate maintenance tasks to be performed.

TROUBLESHOOTING

Troubleshooting procedures are provided in a tabular format which includes: Troubles, their Probable Cause(s), and the Corrective Action(s) required to remedy the trouble(s).

NOTES ON APPENDICES

Appendices A through H are located at the rear of this manual.

Appendix A contains all the diagrams and photographs required to support the text in each chapter. The illustrations are numbered and presented in the order in which they are first referred to.

Appendix B is an alphabetical listing, with definitions, of the abbreviations and designations used in the text and photos of the manual.

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Appendix D is a listing, with definitions, of the mechanical symbols used in the diagrams of this manual.

Appendix E is a listing, with definitions, of the electrical symbols used in the diagrams of this manual.

Appendix F is a list of the references (drawings and publications) used in the preparation of this manual. These references should be utilized to obtain additional detailed information regarding specific components in the system.

Appendix G is a diagram of the World Trade Center Floor-Level Cross-Reference.

Appendix H contains the Manufacturers' Specification Data related to the equipment and components in the Computer Cooling Water System.

241 pages

WORLD TRADE CENTER

Instruction Manual No. 23

Operation and Maintenance of

FIRE PROTECTION SYSTEM

Final Edition
Engineering Department
Publication, February 1986

THE PORT AUTHORITY OF NY & NJ

F O R E W O R D

The information, recommendations, and instructions contained in this manual are provided as an aid and guide to all personnel who operate the Fire Protection System of the World Trade Center.

This manual should be used in conjunction with the standard, emergency fire procedures presently in effect at the World Trade Center.

The contents of this manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The various Fire Protection Systems in the World Trade Center (WTC) are discussed in this manual.

Chapter 1 is the Introduction to the manual and contains information regarding its contents.

Chapter 2 describes the Special Hazard Fire Suppression And Extinguishing Systems in the WTC. These systems include: kitchen ventilating, dry chemical, carbon dioxide, and others.

Chapter 3 deals with the Portable Fire Extinguishers in use throughout the Trade Center.

Chapter 4 discusses the Fire Alarm System in the Trade Center.

Chapter 5 covers the various Smoke Detection and Alarm Systems in the Trade Center.

Chapter 6 focuses on the All-Purpose Public Address System used to make announcements during fire drills or an actual fire emergency.

Chapter 7 describes the various types of Automatic Fire Doors in the Trade Center.